

EDSN - Edison Demonstration for SmallSat Networks

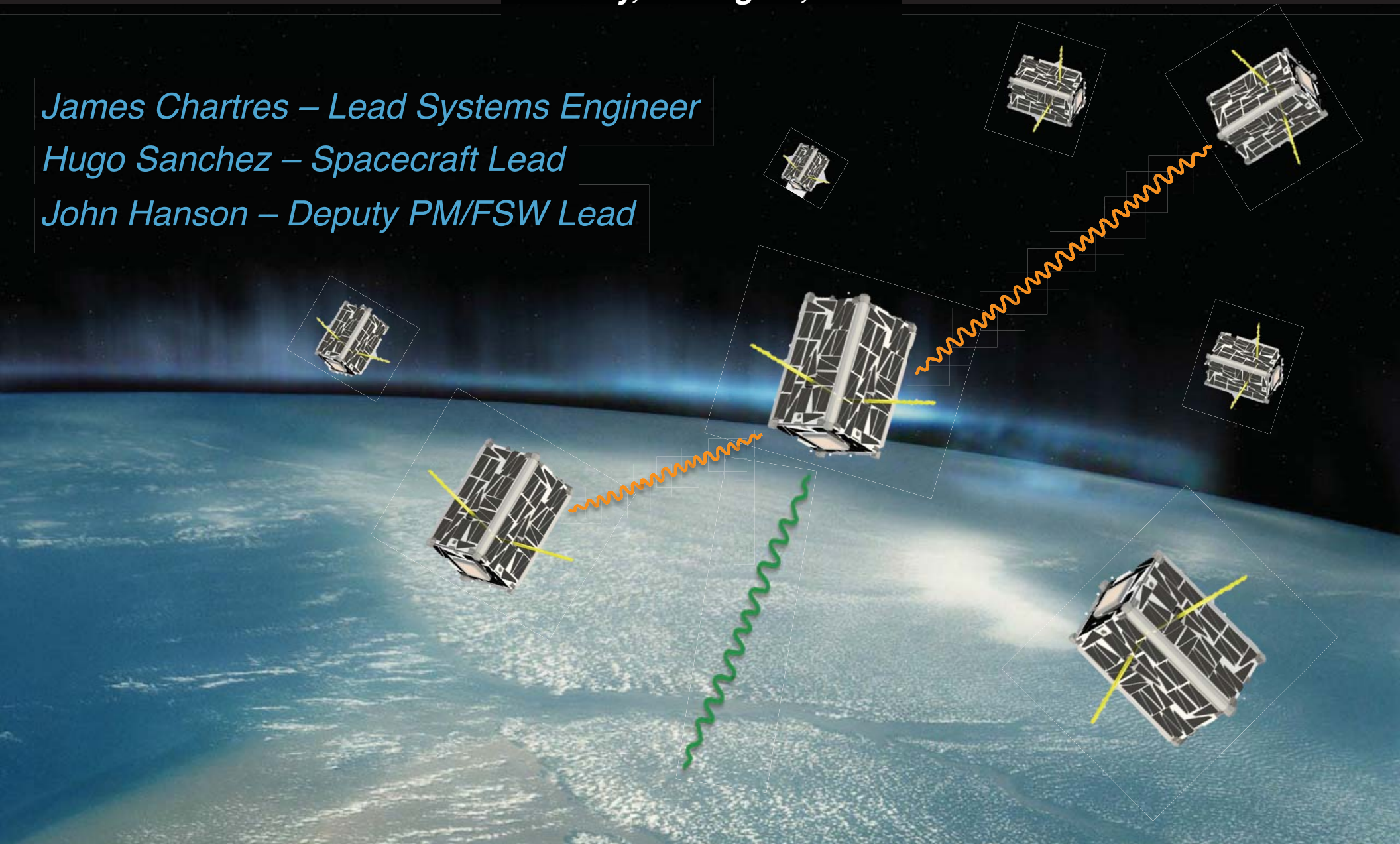
EDSN Development Lessons Learned

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James Chartres – Lead Systems Engineer

Hugo Sanchez – Spacecraft Lead

John Hanson – Deputy PM/FSW Lead





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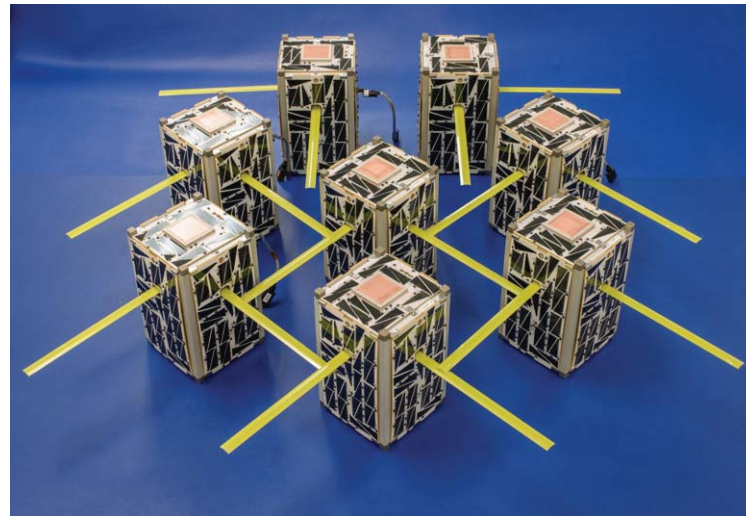


Edison Demonstration of Smallsat Networks

Mission Goal: Demonstrate that a swarm of satellites is capable of collecting multi-point science data and transferring the data to the ground.

Objectives:

1. Flight demonstrate one-way space-to-space data transfer whereby at least 2 satellites transfer data to a third satellite, which then transfers the data to the ground
2. Flight demonstrate a system to collect multi-point science measurements, transfer science measurements to another satellite and transfer to the ground
3. Flight demonstrate a reaction wheel based pointing system
4. Assess the viability of satellites built with Commercial Off The Shelf (COTS) components to operate for 60 days





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Satellite Overview

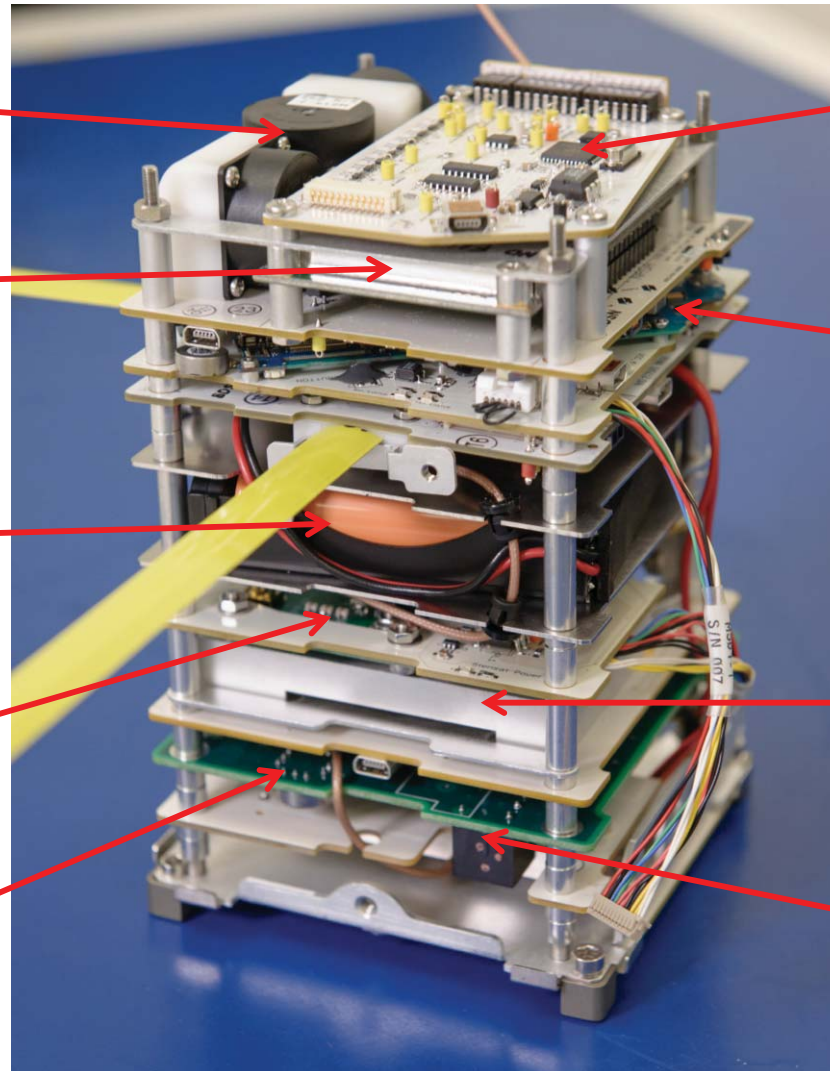
3 orthogonal reaction
wheels

MicroHard MHX2420
for S-band downlink

4x 18650 2800mAh
Li-Ion Batteries

StenSat UHF
transmitter

EPISEM radiation
monitoring payload



Parallax P8X32A
Propeller chip for data
& command routing

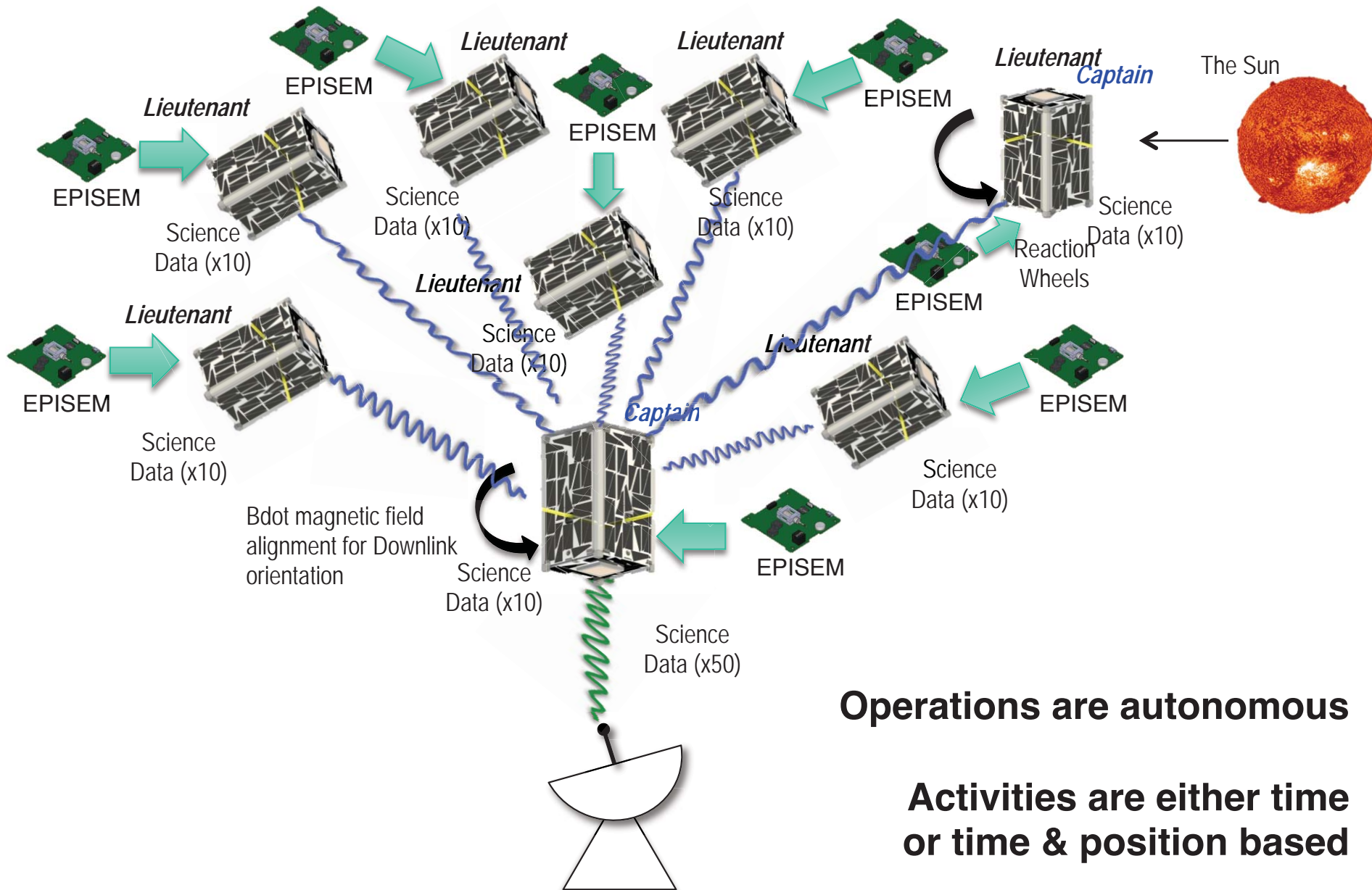
Nexus S Smartphone
as main processor

Novatel OEMV-1
GPS receiver

AstroDev Li-1 UHF
transceiver for crosslink

9 electrical subassemblies inter-connected
via a single backplane PCB

Mission Overview



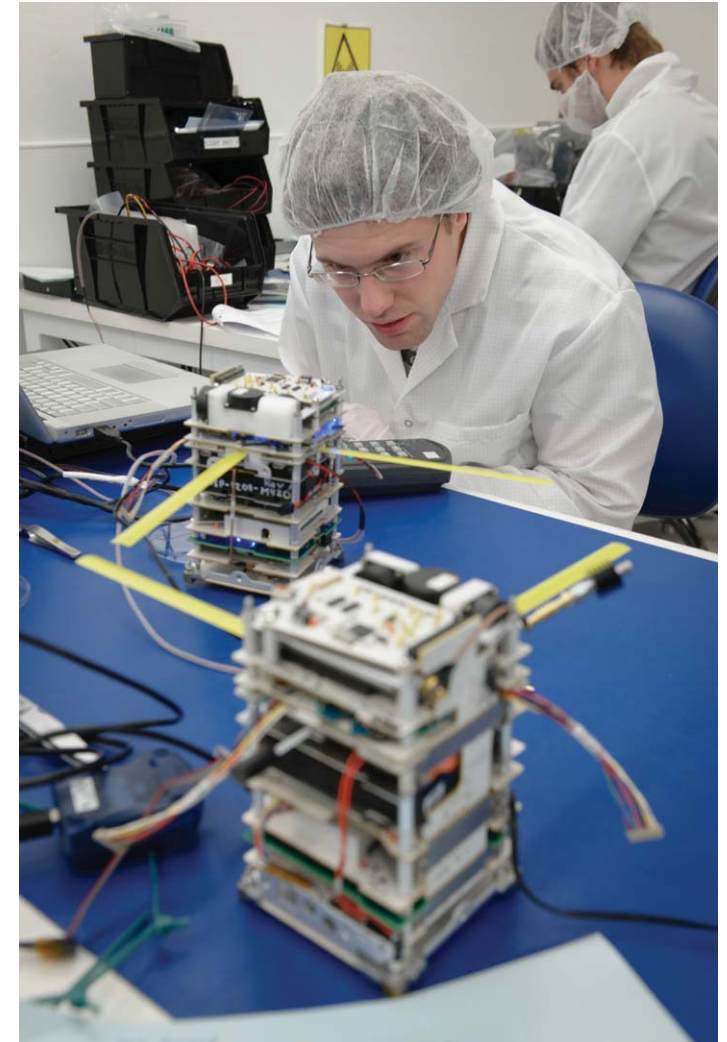


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Development Approach

- Technology Demonstration mission
- Decoupled mission objectives
- Multiple attempts at technology demonstration
- Redundancy through number of units
- Autonomous satellite operations
- Consumer grade COTS components
- Concurrent engineering including design, testing & troubleshooting
- Multiple units including DevSats, FlatSats, EDUs & Flight spares
- Focus on testing versus design analysis





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Development – DevSats & FlatSats

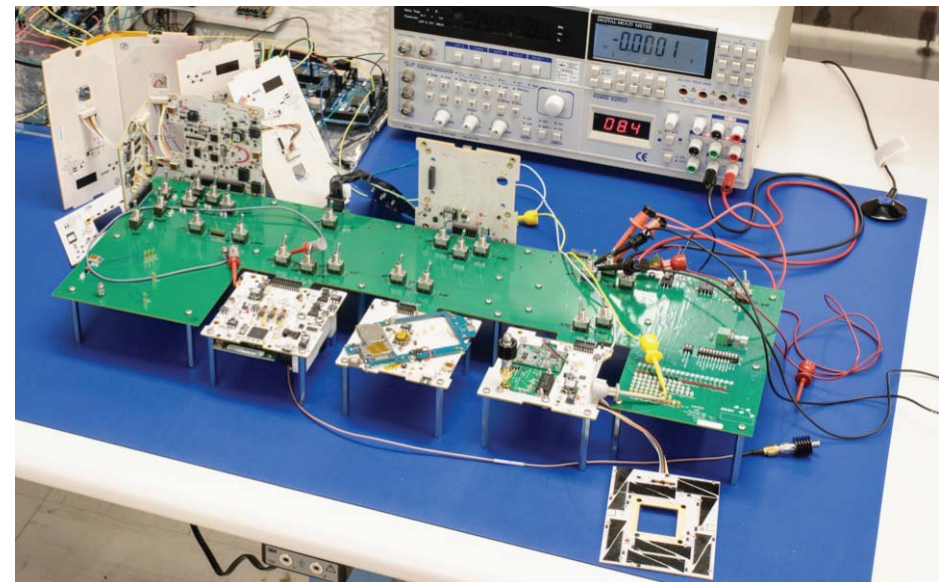
Development Satellites (DevSats)

- COTS development kits
- Identical processors
- Monitor power and data lines
- Rapid and low cost development
- Software development



Flat Satellites (FlatSats)

- Identical PCBs to EDUs
- Reconfigurable
- Turn on/off subassemblies
- Monitor power and data lines
- Allowed rapid repeated testing for multiple PCBs
- Stress testing and characterization





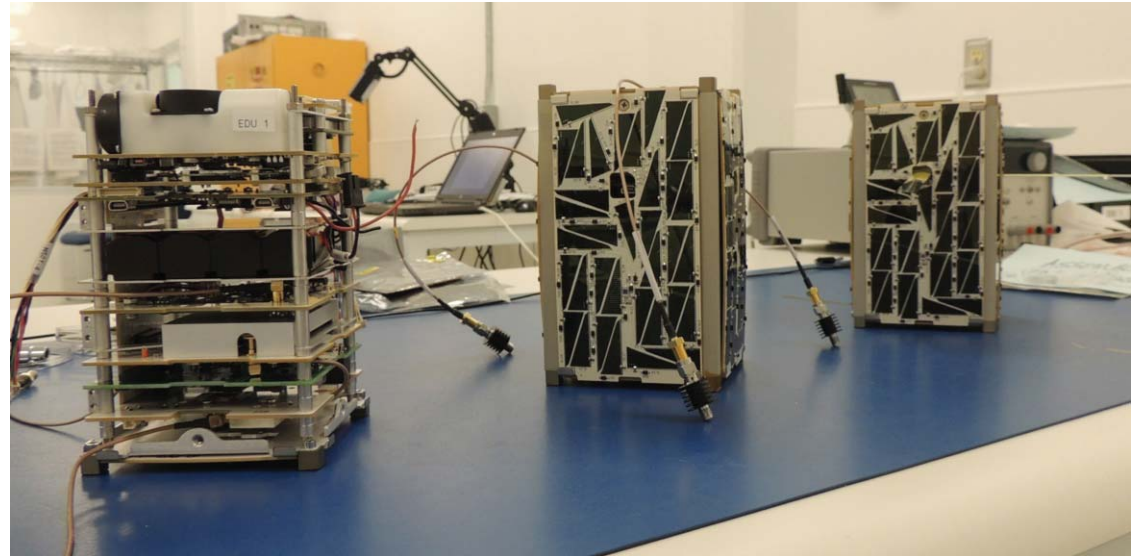
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Development – EDUs & Flight

Engineering Development Units (EDUs)

- Early complete satellites
- RF cables on 2 units
- Early Qualification testing
- Software regression testing
- Mission simulation testing
- Risk reduction



Flight Units

- Modifications from EDUs
- Flt 1-2 Qualification
- Flt 3-12 Acceptance Testing
- 10 day Mission Simulation using flight parameters
- Select top 8 units for flight
- Spare flight units





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Lessons Learned

- Tracking components and units
 - Paper travellers used required overhead
 - Recommend a more automated system
- Procedures for multiple people
- Procedure detailed tuned to task
- Credible descopes
- Stakeholder involvement
- Renting common GSE equipment
- Combined weekly stakeholder meeting
- Project pace enabled by co-location and daily tags
- Dedicated schedule with daily review and weekly status



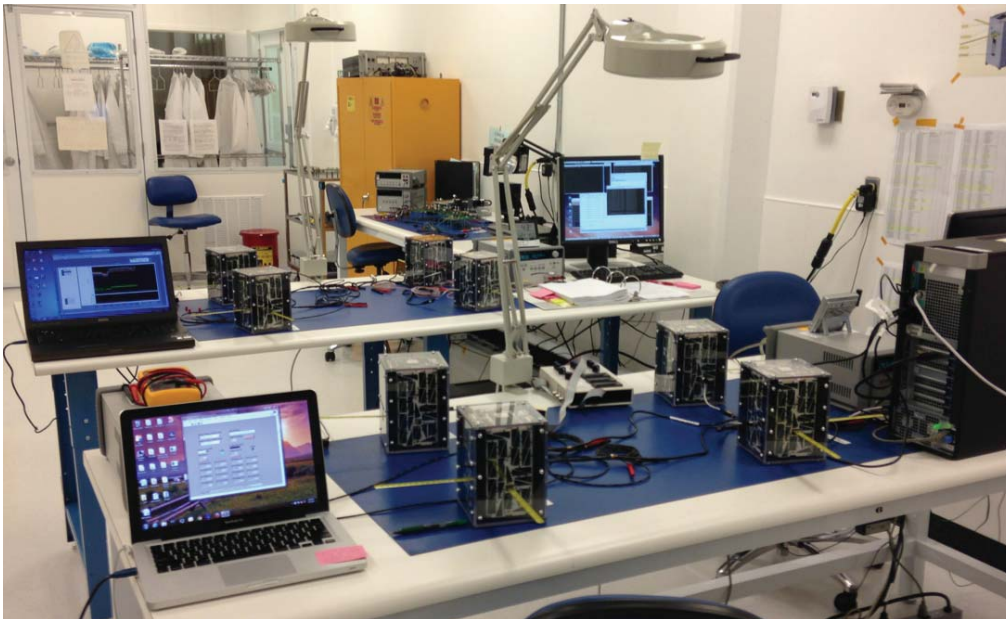
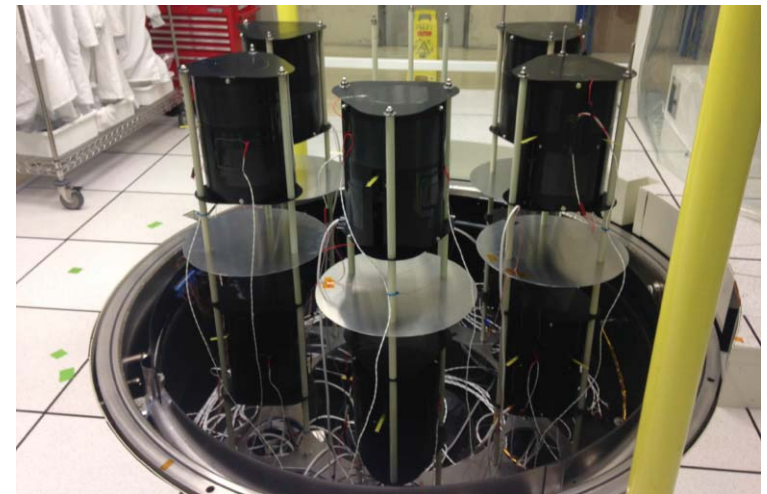


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Anomalies and Resolutions

- Workmanship
 - Inspection, buddy system, sparing
- COTS parts
 - Sparing, subassembly testing
 - Connector issues
 - Higher grade Auto/Ind grade
- Connector saver for external ports



- MOSFET issue
 - Internal ESD
 - Known vendors
- Software development tools
 - JIRA Track bugs
 - Regression testing
- DevSats, Flatsat, EDUs
- Ground Support Equipment
 - Account for interaction affects
 - Testing of software

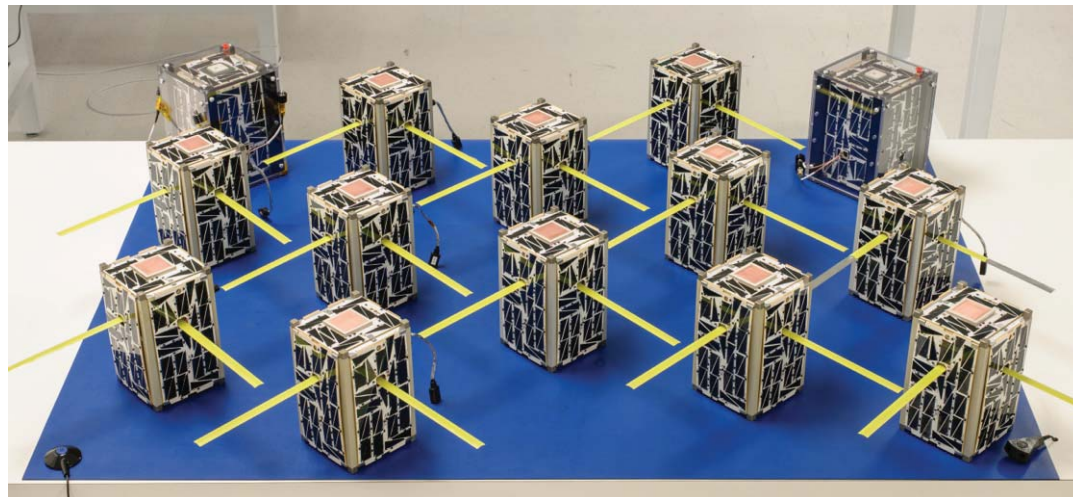


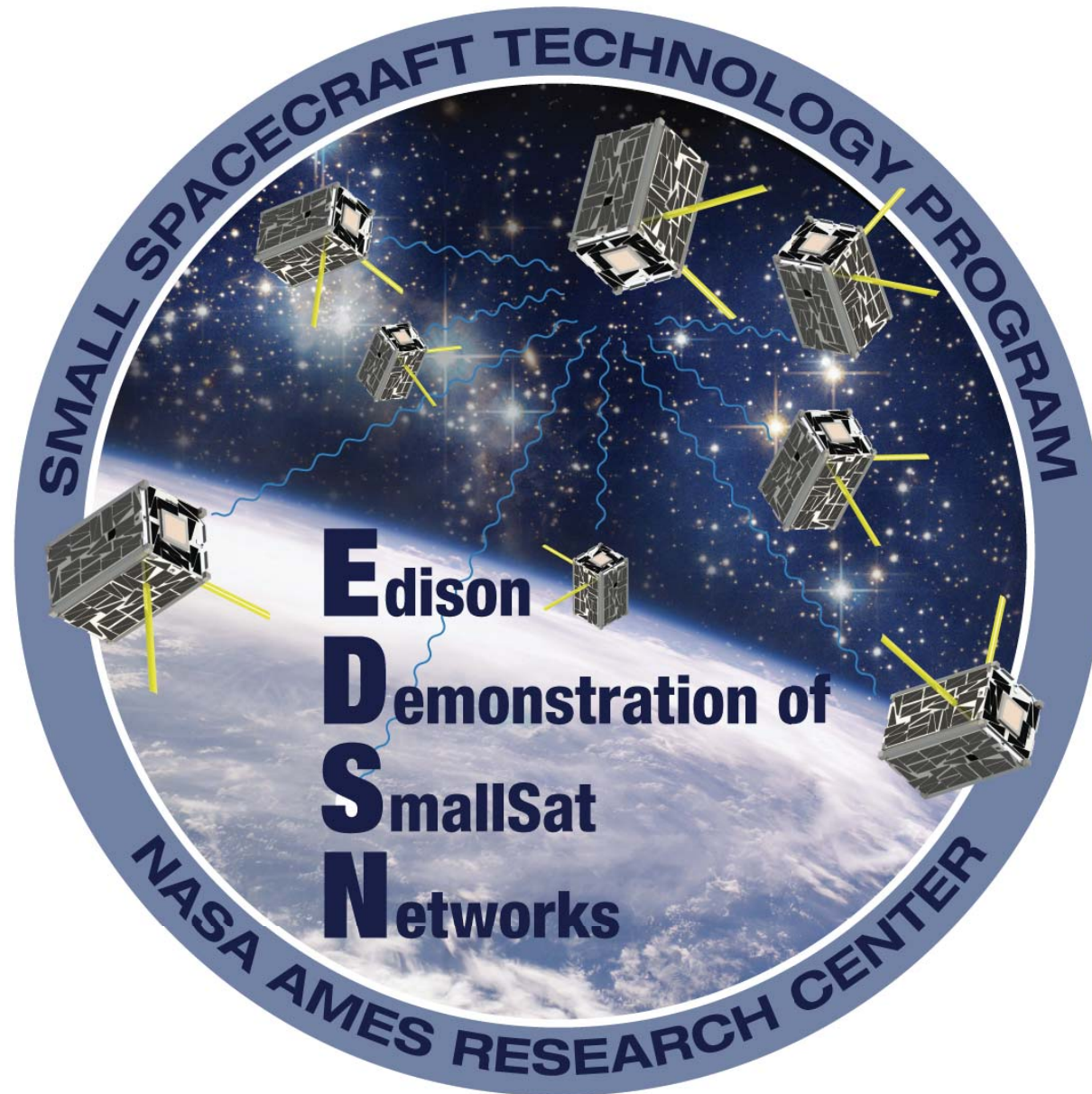
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EDSN Development Lessons

- Development of multiple Cubesats is possible and cost effective
- Development approach and processes change
- Configuration Management is essential
- Concurrent engineering required twice as many units
- Testing early and often resolved issues
- Swarms and constellations allow tailoring of risk posture
- Integration and testing of multiple units has additional considerations





Questions?